

Notes for Dot Patterns Video

The purpose of using dot patterns is to foster children's development of patterns for numbers to 6. (The single ten-frame described in a separate video and a separate set of notes is used for the numbers 6 to 10). The importance of such patterns is that children then have ways to reason about these small numbers without having to count them one by one. Through the dot pattern activities children develop number relationships for these small numbers that contribute to their beginning development of number sense.

Dot pattern activities can be used productively in conjunction with finger pattern activities. Like the finger pattern activities, dot pattern activities contribute to children's developing imagery for small numbers, including partitioning of small numbers. At the same time, they have features not present in the finger pattern activities, which we will elaborate on.

There are three Dot Pattern activities. They are:

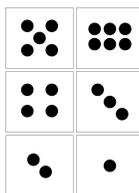
- Dot Card Activities
- Dot Pattern Flashing
- Random Chips

We recommend using dot pattern activities for only a brief time at the beginning of the school year and in conjunction with finger patterns. First grade teachers will find it useful to use these activities for several lessons, possibly up to 6 lessons, moving quickly to the ten-frame activities. Grade K teachers will find it useful to use dot pattern activities for a longer period of time and beginning several weeks later in the school year. A suggested timeline and several suggestions specific to grade K are included at the end of these notes.

One feature of the dot patterns not present with finger patterns is that with dot patterns students encounter already formed patterns. The cognitive demands of dot pattern tasks involve children attempting to make sense of quantities that are presented to them. The child has to use what he knows and understands to interpret the patterns shown, unlike finger pattern activities where students create their own patterns. The other distinguishing feature in the dot patterns that differs from finger patterns is the dot pattern flashing. The flashing promotes mental imagery for small numbers. When students have developed mental imagery for numbers, they have means for reasoning entirely internally, thus reducing the need for external materials.

Dot Card Activities

For these activities each child has one set of dot cards to use. Each set of cards consists of one card for each of the numbers 1 to 6. We have chosen the dice patterns for this purpose.



While this choice is somewhat arbitrary, it has benefits in that children use dice for several different activities throughout the year. The dot cards can be used for whole class activities and for partner work.

Let's look at two example activities. In the first example, the teacher holds up the 5-pattern card. She then asks her students, "Hold up two cards that together make that quantity." Example two is a more difficult variation of this activity. In this example the teacher asks her students to hold up two dot cards that make 9.

Let's take a deeper look at what students might do when the teacher poses the second question, "Hold up two dot cards that make 9." One student, Sam, might approach this task as follows. Sam picks up two cards at random, for example, 4 and 2. He then counts, "1, 2, 3, 4, 5, 6." Not only does Sam count from 1 but he also tags each dot as he counts. He knows, "That's not 9." Next, he picks up two new cards. This time they are the cards with 5 dots and 6 dots. Again he counts all of the dots, "1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11. That's not it. I'll try two more." Many beginning first graders are like Sam. They continue choosing two different cards and count from 1 each time until they eventually count 9 as the total.

Another child, Maria, begins the same way as Sam. She also picks up two cards at random, the 4-card and the 2-card, and counts, "1, 2, 3, 4, 5, 6." But after this initial step Maria proceeds in a different. She thinks, "I need some more. I'll try this one." She keeps the card with 4 dots and picks up the 6-card. Her selection might be random or it might be the result of reasoning that she needs a larger number than 2. Again, Maria counts, "1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Wait." At this point Maria puts back the 6-card and selects the 5-card. This time instead of counting from 1, she counts on from 4, "4, 5, 6, 7, 8, 9. That's the one."

We have often seen children like Maria change from counting all of the dots from one to simply counting on. This example illustrates one of the important benefits of the dot card activities. Children count from one repeatedly and eventually cease doing so, using the results of their immediately prior counting activity to count on. At this point, we see learning taking place. The child has shifted from needing to *count all* to being able to *count on* in this specific situation. We hasten to add that repeatedly counting the dots on a single card, as in the example above, is the factor that was instrumental in the learning. Yet no teacher would ever pose the task of counting a single card over and over again. It would seem like a senseless task. However, in the example above, it is the child that decides to do so. Maria did it because it served her need.

Partner variation of dot card activity.

The same activity can be used as partner work. In this case, the students take turns being the teacher, posing tasks to one another.

Dot Pattern Flashing

In the Dot Pattern Flashing activity the teacher uses chips to flash a number pattern for a number 6 and under. The children's task is to figure out how many dots there are and

explain how they figured it out. The discussion centers around the children's thinking and reasoning, with an emphasis on descriptions that refer to groups of dots and how they used that to figure out the total.

Example:

A teacher might begin by saying, "1-2-3 how many dots you see?" and show the pattern shown here.



The visual material is shown briefly and then removed from view for a short time. This process is repeated for up to three peeks. After the third peek, she leaves the image off and asks students how many dots were flashed. Typically the teacher shows the image as the discussion progresses so that the children can understand what others are saying.

What is the purpose of flashing the pattern? The use of *flashing* rather than simply *showing* the pattern is deliberate. If the pattern is shown rather than flashed, most children will count by ones. But the purpose of the dot pattern activities is to advance children beyond counting by ones to using groups and thereby developing number relationships. If the pattern is flashed children's mental activity continues during the time the image is not visible. Typically children get some information from the first peek and know what it is they want to look for in successive peeks. They begin to mentally organize the visual material and continue to think about it even when it is not present. For this reason we suggest using peeks where the visual material is visible for about two to three seconds, followed by about five seconds when the visual material is not visible, repeating this cycle for up to three peeks.

What do children do? Sam might respond to this dot pattern by saying, "I saw 2 and 2 and 1." What might happen now? The teacher surely has some questions. And, possibly she might have noticed some actions Sam engaged in during the flashing. For example, while Sam saw groups of dots rather than counting by ones, something that is positive since our goal is to foster development of imagery for small numbers so that children do not count by ones, Sam did not state how many dots there are in all. The teacher may be wondering, "Did Sam know that there are 5 dots? Or did he conceive of the activity as one in which you report seeing groups of dots?" She might want to know if Sam just knows that 2 and 2 are 4, something that is quite likely because students have already been working with finger patterns for several days. So what is the teacher's next move? One approach is for the teacher to follow Sam's remarks by asking one or more questions to find the answers to what she is wondering about. For example, she might ask, "Sam, did you figure out how many there are in all? Do you have a way to do that?" We can assume that Sam will respond to her, but let's consider the flow of the classroom discourse when the teacher responds in this way. What is the rest of the class doing at this moment when the teacher is talking specifically to Sam?

Now let's consider a different response from the teacher to Sam's contribution. Another approach is for the teacher to put her own questions aside for now and get the class involved in the discussion right away. How might she do so? One way could be to ask,

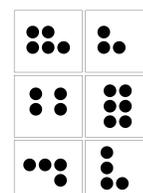
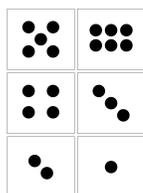
“Who knows what Sam is talking about?” or “What do you understand about what Sam just said?” If no one speaks, the teacher can then call on someone by name and asks the same questions. “Armando, do you know what Sam is talking about? What do you understand about what Sam said?” In first grade classes we've worked in recently, if Armando doesn't say anything when asked, we then ask him, "Would you like to hear it again?" If Armando says, "Yes," we tell him to say that to Sam.

What are the benefits of the second approach? What will happen if the teacher uses the second approach? Other students will get involved. For example, one child might say, “Sam how many dots did you see altogether?” Another might offer, “I have a different question for Sam.” Yet a third child might say, “I understand what he did because that 2 and 2 make 4.”

Let's look more closely at how teachers might facilitate this discourse as we consider Maria's response to the flashing task. Maria states that she saw 4 and 1 and that's 5. Here the teacher might want to ask, "Where is the 4?" This is the most natural question and surely a topic that is worthy of discussion because we know that children will learn from it. But, if the teacher asks that question and Maria answers it, there are no good questions left for the students. So here again, one approach is for the teacher to figure out how to get the class involved. One of the best questions a teacher can ask for that purpose is, “What do you understand about what Maria said?” or “What do you understand about how Maria figured this one out?” In our experience, teachers have to work hard on themselves to open up the discussion rather than to immediately start off directing it to something they think is relevant.

Which patterns to flash?

The word pattern implies that what is flashed is not random but is arranged in some way. The standard dice patterns are good choices to use. Children encounter these patterns in many places outside of school and will encounter them in school when playing games that use dice. (As an aside, sometimes parents ask what they can do to help their child at home with math. One good suggestion is that they play board games because through playing such games, children gain familiarity with the dice patterns.) Other patterns are useful as well. The purpose is not to have a great variety in patterns but to use standard patterns shown below on the left and additional patterns as shown on the right where children can see groups that they can use to figure out the total. Of course many children will then use their finger patterns to figure out the total of the groups they identify. The point is that through this activity, especially through the discussion, explicit attention is drawn to the groups that make up these small numbers.



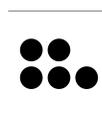
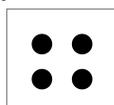
We want to make one more point about patterns that support groups. Not all dot patterns support grouping. Let's say that the teacher flashed the common dot pattern for 3 that is on a regular 6-sided die. The children's task is to say how many dots they saw and how they figured it out. Since this is a very small number, a child would be perplexed by the question, "How did you figure it out?" He might just say, "I just knew that was 3." It is well known that people, and even some animals, easily immediately recognize patterns up to 4 visually. By contrast, consider the following dot pattern.



This pattern is more likely to generate more conversation. A child might say, "I counted them 1, 2, 3. And I got 3." Someone else might say, "I saw two in the top row and 1 in the bottom row." The child may add, "And that made 3." Another might say, "I saw two on the left and one on the right. Two and one make 3." Each of the last two children reported a partitioning of the number 3. Such apparently elementary remarks are potentially useful for the child that counted by ones.

We want to make a pragmatic comment about the chips that you use. While some instructional materials suggest using dot patterns that involve different colors to emphasize a particular group, we recommend that you use chips that are all the same size and the same color to maximize the potential for children to see a variety of different groupings.

We emphasize that the dot pattern flashing activity does not have as its sole purpose that children develop imagery for the specific dot patterns shown. Rather, the activity is intended to promote overall advances in children's conception of number and number relationships. For this reason, we suggest that showing several different quantities on the same day can enhance children's learning opportunities. For example, the teacher might flash a dot pattern for the number 4, have the ensuing discussion, and next flash a dot pattern for the number 5.



In the ensuing discussion of the dot pattern for 5, children might then point out relationships between the two. For example, some children might see a pattern for 4 within the pattern for 5. Others might notice that while they saw the pattern for 4 as 2 and 2 more, they see the pattern for 5 as 2 and 3 more. These seemingly simple observations are important learning opportunities as children develop their own world of number relationships.

Finally, we want to emphasize that in our approach to instruction, we don't devote one lesson to each quantity, e.g. one lesson to the number 3, another to the number 5, etc. We suggest that when teachers plan their lesson they consider how one task might support students' reasoning about a subsequent task.

Random chips

This small activity that is used only once is a very important part of the sequence and should not be omitted. It is to be used after most of the children have become efficient at the flashing task by regularly using groups of chips to figure out the amount rather than counting by ones. In this activity the teacher flashes a random arrangement of either 6 or 7 chips. The children's task is to figure out how many chips there are. However, the question posed after the chips are flashed is not, "How many did you see and how did you figure it out?" but instead is, "Was this one easy or hard to figure out?" The discussion focuses on the fact that this one was harder because there was no pattern and therefore you had to count. It is easier, that is more efficient, when there is a pattern because you do not have to count. In other words, in this class, efficiency means *not counting* by ones. Establishing that efficiency means *not counting* is the entire purpose of this activity. From now on, through the remainder of the school year, when posing a task the teacher can say, "Try to figure it out in an efficient way. Try to do it without counting." Having said that, we are fully aware that some children will still need to count by ones for some time. However, one way to help children advance beyond counting is to continually call attention to coming up with a way to figure out the task "without counting." (That also means that when calling on a student the teacher needs to avoid saying, "How did you count it?")

Timeline

Here we show a suggested timeline. As we noted earlier, Dot Patterns activities can be used productively in conjunction with Finger Pattern activities. Our experience is that the dot card and dot flashing activities can be used effectively over one or two weeks early in the school year. Each teacher will use her own judgment about when to no longer use an activity. A way to make that judgment is to notice when children are no longer learning anything new from an activity. A lesson can easily be comprised of dot pattern flashing or whole class dot card activities (and/or finger pattern activities) followed by partner work with dot cards.

SUGGESTED TIMELINE FOR FIRST 6 WEEKS OF GRADE 1

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
PATTERNING						
Finger Patterns	-----	-----	-----	-----	-----	-----
Dot Patterns		-----				
Single Ten-Frame			-----			
PARTITIONING						
Monkeys in the Trees					---	---
Double Decker Bus						-- --
All the ways						-- --
ADDITIONAL ACTIVITIES						
Hidden Objects			---	---	---	---
Single Bus				---	---	---
Doubles		---	---	---	---	---
Money					---	---

Activities specifically intended for grade K

The following activities are especially useful for kindergarten where children are often just learning to associate quantity with its number word or numerical symbol. They use the same set of dot cards described above.

- The teacher says a number or shows a numeral. The children's task is to hold up the card that shows that number of dots. The same task can be used as partner work where the partners take turns being the teacher and the other partner shows the card with that number of dots.
- The teacher says a number or shows a numeral. The children's task is to hold up two cards that together have that number of dots. The same task can be used as partner work.
- Similar activities can be used with a mixed set of cards consisting of one dot card for each number 1 to 6 and also a numeral card for each number 1 to 6.
- The game GO FISH can be played using a mixed set of cards or by using a card set with multiple copies of each dot card.